BEFORE THE SOUTH CAROLINA PUBLIC SERVICE COMMISSION
DOCKET NOS 2019-185-E, 2019-186-E

EXHIBIT No. 15

LATE-FILED BY
SOUTHERN ALLIANCE FOR CLEAN ENERGY AND
SOUTH CAROLINA COASTAL CONSERVATION LEAGUE

I. Why Detailed Information About Resource Adequacy Studies is Important

In Appendix A to his report filed as Exhibit B to his direct testimony,[1] Mr. Wilson explained the importance of detailed information and sensitivity analyses[2] to validate resource adequacy modeling and allow stakeholders to gain confidence that the assumptions and results are realistic:

> 1. Resource adequacy studies necessarily involve numerous assumptions about loads and resources. To fully evaluate such a study requires a careful review of the various assumptions and how they interact through the simulation to create the study results. Of critical importance is the probabilistic representation of loads and resources. Because the approach involves finding the reserve margin to satisfy LOLE = 0.1 (one outage event in ten years), the loss of load will occur only under extremely low-

[1] *Review and Evaluation of Resource Adequacy and Solar Capacity Value Issues with regard to the Duke Energy Carolinas and Duke Energy Progress 2018 Integrated Resource Plans and Avoided Cost Filing*, February 12, 2019, Exhibit B to Mr. Wilson's direct testimony in this proceeding ("Wilson Report").
[2] A sensitivity analysis is an exercise where the values for one or more assumptions are changed and the model is re-run, to understand the impact of the change in assumptions on model results. Sensitivity analysis will often show that some assumptions, across a broad range of reasonable values, have little impact on the model results; such assumptions are shown to be relatively unimportant. In other instances, sweeping an assumption across a range of reasonable values may have a large impact on model results, which calls attention to how the values for the assumption have been set, and/or may suggest a flaw in the structure of the model.

probability combinations of load and resource conditions. Therefore, to validate such a simulation (to gain confidence that the various assumptions are realistic, individually and in combination, and combine to produce realistic results) requires careful review of, among other things, the combinations of multiple rare events that lead to the loss of load. More specifically, it is necessary to examine when the loss of load occurs (what seasons, weather conditions, hour of the day), the load levels when load loss occurs (combining economic and weather uncertainty assumptions), the availability of all generation resources when load loss occurs, the reasons for lack of availability (including purchases, demand response, and energy-limited resources such as pumped hydro).

2. A thorough review should also consider the results of additional sensitivity analyses around various assumptions, to understand the impact of the assumptions on the results and recommendations. Sensitivity analysis will often reveal that the results are unexpectedly sensitive to certain assumptions. This may suggest flaws in the model logic, and/or a need to more carefully consider the particular values chosen for the assumptions.

At the hearing Mr. Wilson testified that a regular process for updating a resource adequacy study is especially important when there are significant changes to the model or its inputs.[3] Mr. Wilson noted that the Duke Companies' 2016 resource adequacy studies prepared by Astrapé Consulting ("2016 RA Studies") represented such significant

[3] Tr. Vol. 2, p. 59, 2 – p. 59, 20.

changes, with the new focus on winter risk and the large shift of risk to winter periods, according to the analyses.[4] [5]

II. Best Practices in the Development of Resource Adequacy Studies

At the hearing Mr. Wilson further discussed the processes whereby some utilities that prepare resource adequacy studies (and in particular Regional Transmission Organizations such as PJM Interconnection, LLC, "PJM") perform annual updates to their resource adequacy studies.[6] Mr. Wilson recommended PJM's process as an example of a better practice than Duke Energy's process for developing and implementing its 2016 RA studies, and the PJM process could serve as a model that the South Carolina Public Service Commission could look to for guidance going forward.

PJM documents its resource adequacy analyses in an annual report, the PJM Reserve Requirements Study ("RRS").[7] Figure IV-1 on page 70 of the 2019 RRS summarizes the timeline for the preparation of the 2019 study, showing that the process takes about 14 months and involves review by various stakeholder groups throughout the process, with the final steps being a recommendation from the Members Committee and approval by the PJM Board. Attachment A to this filing is a timeline for PJM's 2019 RRS, which includes multiple opportunities for the RAAS to comment on draft

[4] Tr. Vol. 2, p. 52, l. 12 – p. 53, l. 14.
[5] The need for careful validation and sensitivity analysis of the 2016 RA Studies was even more important in light of these reports' conclusions that resource adequacy risk has shifted to winter, which stands in contrast to results for colder regions to the north (Midcontinent ISO, PJM, New York ISO, and ISO New England) that all remain summer peaking with the majority of loss of load risk in the summer.
[6] Tr. Vol. 2, p. 43, 13 – p. 44, 9.
[7] The latest PJM RRS approved by the PJM Board (2018) is available here: https://www.pjm.com/-/media/planning/res-adeq/2018-pjm-reserve-requirement-study.ashx?la=en. The latest RRS (2019) is currently moving through the endorsement process. It was endorsed by the Members Committee on October 31, 2019, and is available here: https://www.pjm.com/-/media/committees-groups/committees/mc/20191031/20191031-item-01-2019-pjm-reserve-requirement-study-report.ashx.

assumptions and the draft report, and a stakeholder process for the review, discussion, and endorsement of study results. Especially when there is a significant change to the underlying data or methodology, stakeholders in the Resource Adequacy Analysis Subcommittee ("RAAS"), who represent a wide range of interests and relevant expertise, are likely to have many comments and suggestions to further evaluate and improve the study. PJM often adjusts its model and assumptions based on the stakeholder input. PJM also generally accommodates any stakeholder request for sensitivity analyses of the RRS. The 2019 RRS contains 24 sensitivity cases in its Appendix B (pp. 64-68). As a result of this process, the final report is generally technically sound and endorsed by a large majority of stakeholders. Other RTOs follow similar processes with substantial stakeholder input when preparing resource adequacy studies.[8]

In contrast to the processes following by PJM and other RTOs, the 2016 RA Studies were prepared without such stakeholder input. Duke Energy's 2016 RA Studies were prepared by Astrapé Consulting using the SERVM model. The 2016 RA Studies represent substantial changes over prior resource adequacy studies, primarily to address increasing concern about winter risk. However, as this proceeding has revealed, the 2016 RA Studies contain problematic assumptions and flaws. These shortcomings could have been addressed and corrected before the studies were finalized, had there been a substantial and transparent stakeholder process. Once the 2016 RA Studies, and the Integrated Resource Plans and Capacity Value analyses that rely upon them, were

[8] See, for example, ISO New England, *Installed Capacity Requirement*, https://www.iso-ne.com/markets-operations/markets/forward-capacity-market/fcm-participation-guide/installed-capacity-requirement (describing, with many links, the stakeholder and regulatory process for approval of the New England Net Installed Capacity Requirement, and the methodology for its calculation).

released, the Companies were very reluctant to acknowledge any flaws or to make any changes.

Furthermore, as Mr. Wilson's report also notes, in the initial Integrated Resource Plan proceeding that included review of the resource adequacy studies, the Companies refused to provide many details about the 2016 RA Studies, and refused to provide requested sensitivity analyses.[9] The attached data requests (from NCUC Docket No. E-100, Sub 157) show that the Companies refused to provide standard model reports, or to perform additional simulations or sensitivity analyses, with a typical response as follows:[10]

> "The Companies object to this data request to the extent that it seeks to have them run new modeling which does not exist, would be time-consuming and costly, and therefore is unduly burdensome and overbroad."

Duke Energy even refused to provide standard SERVM reports that they claim were not turned on during the final model runs:[11]

> "No debug reports or input validation reports were turned on in the final runs so these reports do not exist."[12]

Mr. Wilson disputed in his report (p. 27) that re-running a model is burdensome or costly.

[9] Wilson Report pp. 26-27.
[10] Response to Data Request SACE/NRDC/Sierra Club 4-3 in NCUC Docket No. E-100, Sub 157, Attachment B.
[11] Response to Data Request SACE/NRDC/Sierra Club 4-7 in NCUC Docket No. E-100, Sub 157, Attachment B.
[12] SACE and CCL did not request this information in the SC PSC Docket Nos. 2019-185-E and 186-E but SACE did request it in earlier related proceedings in North Carolina and received responses as discussed above. In several instances, Duke Energy claimed the data did not exist and they were unwilling to produce it, rather than expressly withholding existing information.

The refusal to provide details about SERVM model runs or sensitivity analysis has a long history; Mr. Wilson encountered such opposition in performing a peer review, at the request of the Eastern Interconnection States Planning Council ("EISPC"), of earlier Astrapé work.[13]

III. Recommendations for Future Resource Adequacy Studies

Mr. Wilson provides the following recommendations for future IRPs and resource adequacy studies, consistent with pages 24-25 of his report:

1. The Companies should study the relationship between extreme cold conditions and load, taking into account other relevant factors such as likely facility closures and the impact of wind speeds, to inform future resource adequacy studies.

2. The Companies should further research the drivers of sharp winter load spikes under extreme cold conditions, and develop programs for shaving these rare and brief spikes.

3. The Companies should research the potential for load forecast errors due to economic and demographic forecast errors, and the realistic extent to which this could ultimately lead to less capacity than planned in a delivery year, also to inform future resource adequacy studies. Resource adequacy studies must be internally consistent in their assumptions in this regard – if the potential for

[13] James F. Wilson, Principal, Wilson Energy Economics; Comments On: *The Economic Ramifications of Resource Adequacy Whitepaper, January 2013, prepared by Astrapé Consulting for EISPC and NARUC;* March 24, 2013, pp. 1, 12-13 (noting that only one of fourteen recommended sensitivity analyses was performed, and recommending that EISPC require additional sensitivity analysis) available at http://wilsonenec.com/dev/wp-content/uploads/2016/07/Wilson-comments-on-Astrape-EISPC-Whitepaper-March-24-2013-r.pdf.

adjustments to the resource mix in a one- or two-year ahead time frame are not modeled, only one year of economic load forecast uncertainty should be modeled.

4. The Companies should provide much more scenario analysis and sensitivity analysis of its studies for determining reserve margins and seasonal, monthly, and hourly capacity values. The sensitivity of the recommendations to key assumptions should be explored and documented. For example, as shown above, the 2016 RA Studies results are very sensitive to the choice of 20 or 30 historical weather years, to the details of how extreme cold is assumed to affect load, and to demand response assumptions; such sensitivities should be explored and documented with any such study. The sensitivity of the recommendations to various assumptions that can change over time, including assumptions that could change due to price signals or utility programs, should also be provided.

5. More detailed information about future resource adequacy and related studies should be required. To start, all model reports, and a more comprehensive set of sensitivity analyses, should be provided.

Based on Mr. Wilson's testimony at the hearing, it is further recommended that a process be established for stakeholders to review and provide input on preliminary results of the analyses described in recommendations 1, 2, and 3 above, and other proposed assumptions for future resource adequacy studies, before the assumptions for such studies are finalized. Stakeholders should be afforded opportunities to request details of model inputs and outputs, sensitivity analyses, and other model validation information before the studies are finalized. Ideally the process would be similar to the thorough PJM

stakeholder process. At a minimum, the Commission could require an opportunity for up-front stakeholder review and feedback on future resource adequacy studies. This could result in more defensible assumptions and broader stakeholder acceptance of the studies. This would in turn reduce the number of data requests, pages of testimony, and time at hearing spent litigating controversial details of the studies.

Attachment A

Timeline for 2019 Reserve Requirement Study

Figure IV-1: Timeline for 2019 RRS

Annual Reserve Requirement Study (RRS) Timeline - Milestones (Green) and Deliverables (Blue)

Resource Adequacy Analysis Subcommittee (RAAS) related activities

	Description	January	February	March	April	May	June	July	August	September	October	November	December	January	February
1	Data Modeling efforts by PJM Staff														
2	Produce draft assumptions for RRS														
3	RAAS comments on draft assumptions														
4	**RAAS & PJM Staff finalize Assumptions**														
5	PC receive update and final Assumptions. Review/discuss/provide feedback														
6	**PC establish / endorse Study assumptions**														
7	Generation Owners review Capacity model														
8	PJM Staff performs assessment/analysis														
9	**PC establish hourly load time period**														
10	Status update to RAAS by PJM staff														
11	PJM Staff produces draft report														
12	Draft Report, review by RAAS														
13	**RAAS finalize report, distribute to PC. Winter Weekly Reserve Target Recommendation**														
14	Stakeholder Process for review, discussion, endorsement of Study results (PC, MRC, MC).														
14 A	Planning Committee Review & Recommendation														
14 B	Markets and Reliability Committee Review & Recommendation														
14 C	Members Committee Review & Recommendation														
15	PJM Board of Managers approve IRM and FPR														
16	Posting of Final Values for RPM BRA - FPR														

The 2019 Study activities last for approximately 14 months. Some current Study activities, shown in items 1 and 2, overlap the previous Study timeframe. The posting of final values occurs on or about February 1st.

Attachment B

DUKE ENERGY CAROLINAS AND DUKE ENERGY PROGRESS

Request:

Reference Duke Energy's response to SACE/NRDC/Sierra Club DR 1-26, attachment. Please provide this same data, augmented as follows:

a. For each scenario and day with load loss, provide the data for all hours of the same day.
b. For the resource categories (columns labeled Nuclear, Fossil, CT, Hydro, Pump Storage, Purchases, Renewables, Demand Response) provide both the capacity available (not on forced outage) and actual dispatch. Where these values are different, include a code identifying the reason the resource was not fully dispatched in the hour.
c. Provide the relevant price data: locational marginal prices or system lambda, prices at interties, demand response prices, etc.

Response:

The Companies object to this data request to the extent that it seeks to have them run new modeling which does not exist, would be time-consuming and costly, and therefore is unduly burdensome and overbroad. Without waiving these objections, and in the spirit of cooperation, the Companies further respond as follows:

(a) This data is unavailable and would require simulation reruns with those reports turned on.

(b) The values in every hour represent the actual dispatch. The values on row 6 represent the summer nameplate capacity.

If nuclear, fossil, CT, pump storage have available capacity that is less than the nameplate, then they were on forced outage or planned maintenance.

Purchases represent transmission capability and surrounding neighbor excess so there is not a nameplate value associated.

Hydro represents the amount scheduled for run of river plus peak shaving and represents approximately the capability in that month although less than nameplate capacity.

If demand response is less than the summer or winter rating, then the resource was constrained due to program constraints such as number of hours per year or hours per day.

(c) This data is unavailable and would require simulation reruns with those reports turned on.

DUKE ENERGY CAROLINAS AND DUKE ENERGY PROGRESS

Request:

Reference Duke Energy's response to SACE/NRDC/Sierra Club DR 1-26, attachment. Please provide this same data, augmented as described in the previous data request, for DEC and DEP, for the following:

a. The base case that supports the 17% recommended winter planning reserve margin case (IRP p. 8);
b. The 16% winter planning reserve margin sensitivity case (IRP p. 42);
c. The four solar penetration cases documented in the Solar Capacity Value Study (provided in response to data request SACE/NRDC/Sierra Club DR 1-27).
d. Please also provide this data for all 8,760 hours for a single scenario of the base case.

Response:

The Companies object to this data request to the extent that it seeks to have them run new modeling which does not exist, would be time-consuming and costly, and therefore is unduly burdensome and overbroad. Without waiving these objections, and in the spirit of cooperation, the Companies further respond as follows:

(a) The data provided in response to SACE DR 1-26 represents an 18% reserve margin scenario for DEC and 18.3% reserve margin scenario for DEP. Hourly reports were not produced for every reserve margin simulated. This data is unavailable and would require simulation reruns with those reports turned on.

(b) Reference response to SACE DR 4-3(a) and response to SACE DR 4-7.

(c) Reference the following files provided in response to NCSEA DR 3-12 and 3-13 in Docket No. E-100 Sub 158:

DEC Solar Capacity Value Results_Hourly Firm Load Shed_Solar Profiles_NCSEA.xlsx

DEP Solar Capacity Value Results_Hourly Firm Load Shed_Soalr Profiles_NCSEA.xlsx

These files include hourly solar profiles and all hours with firm load shed across each solar penetration level.

(d) The requested data is not available without additional reruns. Reference the files provided in response to NCSEA DR 3-12 and 3-13 in Docket No. E-100 Sub 158 which include all hours with firm load shed across each solar penetration level.

DUKE ENERGY CAROLINAS AND DUKE ENERGY PROGRESS

Request:

Reference the presentation, "2016 Resource Adequacy Study – Outstanding Issues" (attached to the April 2, 2018 Joint Report), and SERVM User Guide v7.58. For DEC and for DEP, and for the base cases that support the recommended winter planning reserve margin case (17%; IRP p. 8) and the 16% winter planning reserve margin sensitivity case (IRP p. 42), please provide the following (or provide access to the following), in .csv format:

a. The "Default Reports" for each case (SERVM User Guide pp. 194-207);
b. The "Debug Reports" for each case (SERVM User Guide pp. 208-220);
c. The "Input Validation information" for each case (SERVM User Guide p. 222) which includes, among other things, the Load Report, which report "...is done after the adjustments have been calculated, so the user can see how the load forecast multiplier and load adder and hydro information have affected the loads."

Response:

(a)-(c) The recommended winter planning reserve margin of 17% represents the average of the required reserves for DEC and DEP to reach the 1 day in 10 year standard. The only default report turned on during the final simulations in the 2016 Resource Adequacy study was the system metrics report which provides LOLE for each reserve margin simulated (reference Table 12 from the 2016 Resource Adequacy Study reports). No debug reports or input validation reports were turned on in the final runs so these reports do not exist.

The 16% reserve margin sensitivity included in the 2018 IRP filing was to comply with the NCUC April 16, 2018 Order in Docket No. E-100, Sub 147 requiring the Companies to present a sensitivity analysis in their 2018 IRPs that illustrates the impact of a 16% winter reserve margin, SERVM was not run for the 16% reserve margin sensitivity included in the 2018 IRPs, and thus no SERVM reports are available.

DUKE ENERGY CAROLINAS AND DUKE ENERGY PROGRESS

Request:

Reference the Solar Capacity Value Study provided in response to SACE/NRDC/Sierra Club DR 1-27. Please provide sensitivity analysis of the solar capacity value by tranche to the following assumptions:

a. The economic load forecast error assumption (p. 20).
b. Demand response contract limits: hours per year, days per week, and hours per day (p. 30).
c. Assumptions limiting the availability of neighbor assistance to amounts less than available transmission (p. 31).

Response:

The Companies object to this data request as it seeks to have them run additional modeling that does not currently exist, would require time-consuming and costly efforts, and is therefore unduly burdensome and overbroad. Notwithstanding these objections, and in the spirit of cooperation, the Companies further reply that the request new modeling with these assumptions would likely have very little impact on the results. The reason is that once these changes were made, the model would need to be calibrated to 0.1 LOLE by increasing or decreasing conventional capacity. If the economic load forecast error assumption was worsened, then capacity would need to increase to get back to 0.1. It is expected that this would do very little to the timing of firm load shed events in the summer or winter and the solar capacity value results would be unchanged. The same goes for demand response limits and neighbor assistance. However, all of these assumptions impact the target reserve margin level which will be re-evaluated as part of the 2020 IRP.